BEFORE THE
PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA

DOCKET NO. 2022-1-E

In the Matter of	)	**DIRECT TESTIMONY OF**
Annual Review of Base Rates for Increase in	)	**TOM RAY FOR**
Fuel Costs for Duke Energy Progress, LLC	)	**DUKE ENERGY PROGRESS, LLC**

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Tom Ray, and my business address is 12700 Hagers Ferry Road, Huntersville, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am Senior Vice President of Nuclear Operations for Duke Energy Corporation ("Duke Energy") with direct executive accountability for Duke Energy's North Carolina nuclear stations, including Duke Energy Progress, LLC's ("DEP" or the "Company") Brunswick Nuclear Station ("Brunswick") in Brunswick County, North Carolina, the Harris Nuclear Station ("Harris") in Wake County, North Carolina, and Duke Energy Carolinas, LLC's McGuire Nuclear Station, located in Mecklenburg County, North Carolina.

Q. WHAT ARE YOUR RESPONSIBILITIES AS SENIOR VICE PRESIDENT OF NUCLEAR OPERATIONS?

A. As Senior Vice President of Nuclear Operations, I am responsible for providing oversight for the safe and reliable operation of Duke Energy's nuclear stations in North Carolina. I am also involved in the operations of Duke Energy's other nuclear stations, including DEP's Robinson Nuclear Station ("Robinson") located in Darlington County, South Carolina.

Q. PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. I have a Bachelor of Science degree in nuclear engineering from North Carolina State University and received a senior reactor operator certification from Duke Energy's McGuire Nuclear Station. My career in the nuclear power industry spans over 30 years. I began my nuclear career as an engineer with the Bechtel Power Corporation where I was field engineer assigned to projects at various nuclear plants. In 1989, I joined Duke Energy as a nuclear

engineer in the corporate headquarters. I transferred to reactor engineering at the McGuire Nuclear Station in 1994, and progressed through leadership roles at McGuire in engineering, maintenance, and outage management. In 2004, I joined the Catawba team as safety assurance manager, and was named maintenance manager in 2005 and engineering manager in 2009. I was transferred to Oconee Nuclear Station as engineering manager in 2010 and was promoted to plant manager in 2012 and vice president of the Oconee Station in 2016. I was named site vice president for McGuire in 2017 and held that position until February 2022 when I assumed my current role.

Q. HAVE YOU TESTIFIED BEFORE THIS COMMISSION IN ANY PRIOR PROCEEDINGS?

A. No.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to describe and discuss the performance of the Brunswick, Harris, and Robinson nuclear plants for the period of March 1, 2021 through February 28, 2022 (the "review period").

Q. YOUR TESTIMONY INCLUDES THREE EXHIBITS. WERE THESE EXHIBITS PREPARED BY YOU OR AT YOUR DIRECTION AND UNDER YOUR SUPERVISION?

A. Yes. These exhibits were prepared at my direction and under my supervision.

Q. PLEASE PROVIDE A DESCRIPTION OF THE EXHIBITS.

A. The exhibits and descriptions are as follows:

Ray Exhibit 1 - Calculation of the nuclear capacity factor for the review period pursuant to S.C. Code Ann. § 58-27-865

Ray Exhibit 2 - Nuclear outage data for the review period

Ray Exhibit 3 - Nuclear outage data through the billing period [1]

Q. PLEASE DESCRIBE DEP'S NUCLEAR GENERATION PORTFOLIO.

A. The Company's nuclear generation portfolio consists of approximately 3,593[2] megawatts ("MWs") of generating capacity, made up as follows:

Brunswick - 1,870 MWs

Harris - 964 MWs

Robinson - 759 MWs

Q. PLEASE PROVIDE A GENERAL DESCRIPTION OF DEP'S NUCLEAR GENERATION ASSETS.

A. The Company's nuclear fleet consists of three generating stations and a total of four units. Brunswick is a boiling water reactor facility with two units and was the first nuclear plant built in North Carolina. Unit 2 began commercial operation in 1975, followed by Unit 1 in 1977. The operating licenses for Brunswick were renewed in 2006 by the NRC, extending operations up to 2036 and 2034 for Units 1 and 2, respectively. Harris is a single unit pressurized water reactor that began commercial operation in 1987. The NRC issued a renewed license for Harris in 2008, extending operation up to 2046. Robinson is also a single unit pressurized water reactor that began commercial operation in 1971. The license renewal for Robinson Unit 2 was issued by the NRC in 2004, extending operation up to 2030.

Q. WERE THERE ANY CAPACITY CHANGES WITHIN DEP'S NUCLEAR PORTFOLIO DURING THE REVIEW PERIOD?

A. No.

[1] This data is provided in confidential and publicly redacted versions for security purposes.
[2] As of January 1, 2022.

Q. WHAT ARE DEP'S OBJECTIVES IN THE OPERATION OF ITS NUCLEAR GENERATION ASSETS?

A. The primary objective of DEP's nuclear generation department is to safely provide reliable and cost-effective electricity to DEP's Carolinas customers. The Company achieves this objective by focusing on a number of key areas. Operations personnel and other station employees are well-trained and execute their responsibilities to the highest standards in accordance with detailed procedures. The Company maintains station equipment and systems reliably and ensures timely implementation of work plans and projects that enhance the performance of systems, equipment, and personnel. Station refueling and maintenance outages are conducted through the execution of well-planned, well-executed, and high-quality work activities, which effectively ready the plant for operation until the next planned outage.

Q. PLEASE DISCUSS THE PERFORMANCE OF DEP'S NUCLEAR FLEET DURING THE REVIEW PERIOD.

A. The Company operated its nuclear stations in a reasonable and prudent manner during the review period, providing approximately 49.6% of the total power generated by DEP. The four nuclear units operated at an actual system average capacity factor of 94.09% during the review period.

As shown on Ray Exhibit 1, DEP achieved a net nuclear capacity factor, excluding reasonable outage time, of 101.80% for the review period. This capacity factor is above the 92.5% set forth in S.C. Code Ann. § 58-27-865(F), which states in pertinent part:

> There shall be a rebuttable presumption that an electrical utility made every reasonable effort to minimize cost associated with the operation of its nuclear generation facility or system, as applicable, if the utility achieved a net capacity factor of ninety-two and one-half percent or higher during the period under review. The calculation of the net capacity factor shall exclude reasonable outage time associated with reasonable refueling, reasonable

> maintenance, reasonable repair, and reasonable equipment replacement outages; the reasonable reduced power generation experienced by nuclear units as they approach a refueling outage; the reasonable reduced power generation experienced by nuclear units associated with bringing a unit back to full power after an outage....

The performance results discussed above support DEP's continued commitment for achieving high performance without compromising safety and reliability.

Q. WHAT IMPACTS A UNIT'S AVAILABILITY AND WHAT IS DEP'S PHILOSOPHY FOR SCHEDULING REFUELING AND MAINTENANCE OUTAGES?

A. In general, refueling requirements, maintenance requirements, and NRC operating requirements impact the availability of DEP's nuclear system. Prior to a planned outage, DEP develops a detailed schedule for the outage and for major tasks to be performed including sub-schedules for particular activities.

The Company's scheduling philosophy is to plan for a best possible outcome for each outage activity within the outage plan. For example, if the "best ever" time a particular outage task was performed is 10 days, then 10 days or less becomes the goal for that task in each subsequent outage. Those individual goals are incorporated into an overall outage schedule. The Company aggressively works to meet, and measures itself against, that schedule. Further, to minimize potential impacts to outage schedules, "discovery activities" (walk-downs, inspections, etc.) are scheduled at the earliest opportunity so that any maintenance or repairs identified through those activities can be promptly incorporated into the outage plan. Those discovery activities also have pre-planned contingency actions to ensure that, when incorporated into the schedule, the activities required for appropriate repair can be performed as efficiently as possible.

As noted, the Company uses the schedule for measuring outage planning and execution and driving continuous improvement efforts. However, in order to provide reasonable, rather than best ever, total outage time for planning purposes, particularly with the dispatch and system operating center functions, DEP also develops an allocation of outage time, which incorporates unforeseen, reasonable schedule delays that may be needed for unplanned equipment repairs found during inspections. The development of each outage allocation is dependent on maintenance and repair activities included in the outage, as well as major projects to be implemented during the outage. Both schedule and allocation are set aggressively to drive continuous improvement in outage planning and execution.

Q. HOW DOES DEP HANDLE OUTAGE EXTENSIONS AND FORCED OUTAGES?

A. When an outage extension becomes necessary, DEP believes that work completed in the extension results in longer continuous run times and fewer forced outages, thereby reducing fuel costs in the long run. Therefore, if an unanticipated issue that has the potential to become an on-line reliability issue is discovered while a unit is off-line for a scheduled outage and repair cannot be completed within the planned work window, the outage is usually extended to perform necessary maintenance or repairs prior to returning the unit to service. In the event that a unit is forced off-line, every effort is made to safely perform the repair and return the unit to service as quickly as possible.

Q. DOES DEP PERFORM POST-OUTAGE CRITIQUES AND CAUSE ANALYSES FOR INTERNAL IMPROVEMENT EFFORTS?

A. Yes. The nuclear industry recognizes that constant focus on operational excellence results in improved nuclear safety and reliability. As such, DEP applies self-critical analysis to each outage to identify every potential cause of an outage delay or event resulting in a forced or

extended outage. These critiques and cause analyses do not document the broader context of the outage or event, and thus rarely reflect strengths and successes.

Q. WHAT IS THE RELATIONSHIP BETWEEN THE STANDARDS THAT THE COMPANY APPLIES IN ITS POST OUTAGE CRITIQUES AND THE "EVERY REASONABLE EFFORT" STANDARD OF SECTION 58-27-865?

A. In the Company's outage evaluations, we are striving to identify any opportunity for improvement. We are not assessing the "reasonableness" of any conduct or actions that might have contributed to the outage. Reasonableness focuses on what was done in light of what was known prior to the event; in our outage evaluations we are focused on learning and applying new lessons from our experiences in order to improve our operations. The fact that an outage investigation may indicate ways we can improve our future operations does not indicate that we have determined that our previous practices did not meet the reasonableness standard.

Q. WHAT REFUELING OUTAGES WERE REQUIRED AT DEP'S NUCLEAR FACILITIES DURING THE REVIEW PERIOD?

A. The Company completed two refueling outages during the review period: Brunswick Unit 2 and Harris.

The Brunswick Unit 2 spring 2021 refueling outage began on March 5, 2021. In addition to refueling, maintenance activities, safety and reliability enhancements, and testing and inspections were completed. Maintenance activities completed during the outage included replacement of the 2A and 2B reactor recirculation pump seals, multiple cryogenic tubing couplings, and replacement of the valve motor operator on the residual heat removal inboard shutdown cooling suction isolation valve. After 45 years of service, the unit's startup

auxiliary transformer was replaced. Other activities included the replacement of five safety relief valve main body assemblies and four source range monitor dry tubes. The unit's manual no load disconnect switch ("NLDS") was replaced with an electronically operated generator circuit breaker. The replacement of the NLDS with a circuit breaker increases the operability margin and improves reliability of the protection device. The Brunswick Unit 1 generator was removed from the grid for just under 2 days during 2020 due to challenges with that unit's switch.[3] To ensure reliability of Unit 2's fuel, ultrasonic cleaning of fuel assemblies and reactor bottom head foreign material search and retrieval activities were completed. Prior to restart from the outage, inspections were completed on 2A and 2B low-pressure turbines, the reactor core isolation cooling system, the east moisture separator reheater, and the nuclear service water header. The outage was successfully completed with no personnel injuries or reportable environmental events and represented the lowest radiation dose and outage duration ever recorded for a Brunswick Unit 2 refueling outage. The unit returned to service on April 5, 2021; a duration of 30.2 days compared to a scheduled allocation of 33 days.

Harris was disconnected from the grid for refueling on April 24, 2021. Maintenance activities, safety and reliability enhancements, and testing and inspections were completed as the unit was refueled. Electrical maintenance performed during the outage included winding penetrations repairs to the unit auxiliary and start-up transformers, refurbishment of 2 vital inverters, and 1A battery replacement. Nuclear instrumentation detector and cable replacements, and turbine control system maintenance was completed during the outage. Reliability enhancements also included stem replacement and inspection of the 'C' main steam isolation valve, and sections of circulating water pre-stressed concrete cylinder pipe

[3] Although not under review in this proceeding, the Unit 1 NLDS was replaced with a breaker during the spring 2022 refueling outage.

was inspected, and a carbon fiber wrap was installed on portions to extend the longevity and address reliability concerns that could threaten unit operations. These inspections and any needed repairs will continue over several future refueling outages. Condenser hardening work, which included inspection and tube plugging, was completed on the circulating water west waterbox, and cooling tower blowdown lines were inspected. The refueling outage was successfully completed with no recordable injuries, no human performance deficiencies, and under budget. After refueling, maintenance, and testing and inspections were completed, the unit returned to service on May 14. The outage duration was 20.4 days compared to a scheduled allocation of 25 days. This represented the shortest refueling outage in the unit's history and was also accomplished with the lowest dose recorded for a Harris refueling outage.

Q. OTHER THAN REFUELING, WHAT OUTAGES OCCURRED AT DEP'S NUCLEAR FACILITIES DURING THE REVIEW PERIOD?

A. Brunswick Unit 1 entered a forced maintenance outage on May 5, 2021, to replace the 1B reactor recirculation pump seal. Based on the extent of condition inspections and to ensure reliability for the remainder of the operating cycle, the 1A reactor recirculating pump seal was also replaced. The unit safely returned to service on May 13, 2021; an outage duration of 12 days.

On May 14, 2021, as Harris was ramping up from the refueling outage and at approximately 30% power, the generator was disconnected from the grid for 13 hours to repair a bracket on the main generator ground detection system.

Harris entered a planned maintenance outage on June 5, 2021, to repair an oil leak on the 'B' unit auxiliary transformer. The leak was repaired, and the unit returned to service on June 8, 2021. The duration of the outage was just under 3 days and 8 hours.

On October 18, 2021, Robinson entered a forced outage necessitated by a leak on the 'A' reactor coolant pump ("RCP") seal. During the repair, operators observed a leak on the 'B' RCP main flange. After the 'A' RCP seal and 'B' RCP flange leaks were repaired, the unit returned to service on November 2, 2021. The duration of the outage was 15.2 days.

The Brunswick Unit 1 generator was disconnected from the grid for 25 hours on December 19, 2021, to repair the 'B' no load disconnect switch. As referenced earlier in my testimony, both Brunswick units have recently experienced reliability challenges with the switches. In the spring 2021 refueling outage, the switch on Unit 2 was replaced with a circuit breaker, and the circuit breaker has performed as designed with no additional challenges on Unit 2.[4]

On January 28, 2022, Brunswick Unit 2 entered a forced outage to address condenser in-leakage and drywell leakage. After inspections and repairs, the unit returned to service on February 4, 2022. The duration of the outage was 6.6 days.

Q. WHAT IS YOUR VIEW OF THE COMPANY'S NUCLEAR PLANT PERFORMANCE DURING THE REVIEW PERIOD?

A. Based on my oversight and review of operations during the review period, the Company's nuclear units were operated reasonably and prudently, and our operations were conducted in a way that minimized our fuel costs. The successful completion of two refueling outages and the achievement of a 94.09 percent capacity factor during the review period validates the Company's performance.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes, it does.

[4] As noted above, although not under review in this proceeding, the same modification replacing the switch with a circuit breaker was completed on Brunswick Unit 1 during the recently completed Brunswick Unit 1 spring 2022 refueling outage,

DUKE ENERGY PROGESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR CAPACITY FACTOR PURSUANT TO S.C. CODE ANN. § 58-27-865(F)
REVIEW PERIOD OF MARCH 2021 THROUGH FEBRUARY 2022

L1	Nuclear System Actual Net Generation During Review Period	29,614,718	MWH
L2	Total Number of Hours during Review Period	8,760	
L3	Nuclear System MDC during Review Period	3,593.00	MW
L4	Reasonable Nuclear System Reductions	2,382,496	MWH
	Nuclear System Capacity Factor = L1/((L2*L3)-L4)	101.80	%

DUKE ENERGY PROGESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR OUTAGE DATA FOR REVIEW PERIOD OF
MARCH 2021 THROUGH FEBRUARY 2022

Nuclear outages lasting one week or more during the Review Period

Station/Unit	Date of Outage	Explanation of Outage
Brunswick 2	3/5/2021 - 4/5/2021	Scheduled refueling (B2R25)
Harris	4/24/2021 - 5/14/2021	Scheduled refueling (H1R23)
Brunswick 1	5/1/2021 - 5/13/2021	Forced maintenance outage to repair reactor recirculation pump seal
Robinson	10/18/2021 - 11/2/2018	Forced maintenance outage to repair reactor coolant pump seal

DUKE ENERGY PROGESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR OUTAGE SCHEDULE THROUGH BILLING PERIOD
MARCH 2022 THROUGH JUNE 2023

Scheduled nuclear outages lasting one week or more through the Billing Period

Station/Unit	Date of Outage[1]	Explanation of Outage

REDACTED

[1] This exhibit represents DEP's current plan, which is subject to change based on fluctuations in operational and maintenance requirements.